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Development of Physics Module Based on Ethnoscience with the Local Wisdom of House Limas Palembang to Improve Thinking Ability

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Abstract: An ethnoscience-based physics module with the local wisdom of Palembang pyramid houses to improve students' creative thinking skills in high school has been successfully developed which is valid, practical and effective. This research aims to produce ethnoscience-based physics modules with local wisdom of Palembang pyramid houses to improve students' creative thinking skills in high school. The research method used was development research with the Rowntree development model consisting of three stages: planning, development, and evaluation. The evaluation stage was conducted by adopting Tessmer's formative evaluation technique. The results showed that the ethnoscience-based physics module with the local wisdom of Palembang pyramid houses developed was categorised as very valid in the material and language components with an average percentage of 95.10% and 92.26% respectively, and categorised as valid in the presentation and display components with an average assessment percentage of 76.25%. The ethnoscience-based physics module with local wisdom is also categorised as very practical after passing the one-to-one evaluation and small group evaluation stages with an average percentage of 95.27% and 95.33% and effective in improving the creative thinking skills of students in high school with an average n-gain of 0.62 The research concluded that improving students' creative thinking skills can be done by using ethnoscience-based physics modules with local wisdom.

Keywords: Creative thinking skill; Ethnoscience; Local wisdom; Module

Introduction

Teaching materials are the most important part of the learning process, one of which is as a learning resource that can contain learning messages, both temporary and general in nature and can be utilized for learning purposes. According to Fitriani (2017) and Magdalena et al. (2020) teaching materials are one of the school facilities that are used as learning resources and references for students in learning independently. In addition, teaching materials are also useful as a guide for a teacher in carrying out teaching and learning activities in the classroom (Arsanti, 2018; Wardani et al., 2023). Teaching materials are grouped into two types, namely, printed teaching materials and non-printed teaching materials (Murwitaningsih & Maesaroh, 2023; Susanti, 2019). One type of teaching material is teaching material in the form of modules.

Modules are teaching materials that are systematically designed to include material content, methods, and evaluation based on a certain curriculum which are packaged in the form of smallest learning units and studied independently within a certain time. (Mardianti et al., 2020). Modules provide opportunities for students to do remedial or improve students' weaknesses in understanding a concept or material on

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an ongoing basis. In addition, the use of teaching materials can also be utilized by connecting culture and history based on aspects of local wisdom found around the place of learning for students. By connecting abstract physics concepts with concrete objects that are familiar to students, such as the Limas House, their understanding of the material will be deeper and more meaningful.

Local wisdom is a way of life and knowledge formed from human behavior towards the surrounding environment that has cultural values that develop continuously (Askodrina, 2022; Kamila et al., 2024; Wirama et al., 2023). Local wisdom is also seen as an intermediary medium for the community in recognizing the culture that has been born from ancient times which can then position local wisdom as a medium in an effort to improve the quality of learning. The physics learning process can be meaningful learning for students when physics material is associated with local local wisdom, for example on the material of Rotational Dynamics and Equilibrium of Fixed Objects. Learning oriented to local wisdom needs to be presented in teaching materials so that students are easier to understand the material and are able to relate the information they get around their daily lives.

Mastery of physics material requires students to think logically, critically, and creatively, therefore the model applied should facilitate students' thinking activities (Isnaniah & Masniah, 2023; Septeanawati F, 2014; Wati et al., 2017). The cause of the weak quality of learning is caused by the weak learning process that does not encourage students to think creatively. Creative thinking is an exploration activity to give birth to new ideas that are different from existing ones (Hasanah & Nulhakim, 2015; Nazhifah et al., 2023).

When students see abstract physics concepts applied to familiar real objects such as the Limas House, they can more easily imagine and understand the concepts (Ramli et al., 2024). For example, the concept of force can be explained by the way the Limas House roof is designed to withstand heavy loads without collapsing. By seeing how the principles of physics work in everyday life, students realize that physics is not just a collection of formulas that must be memorized, but also a science that is very useful in solving problems and understanding the world around them. If possible, students can carry out simple experiments or field trips to Rumah Limas to directly observe the application of physics concepts. This direct experience will make learning more memorable and meaningful.

Based on the results of an interview with one of the Physics teachers at the school, that there is no teaching material in the form of Physics Modules integrated with ethnosis with local wisdom. The teacher also stated that there are still students who are classified as low in creative thinking skills. This is evidenced by Putri et al. (2022), Sari et al. (2024), Sativa et al. (2022) which states that the results of students' creative thinking skills are still in the low category. Then the research conducted by Purba et al. (2022) and Rofiqoh et al. (2020) related to creative thinking skills, the results showed that the average criterion value of 50-79 was obtained in the criteria for achieving creativity in the moderate category.

In addition, further research was conducted by Arini (2017), Utari et al. (2023), and Widya et al. (2023) The results showed that the creative thinking ability of students reached the Less Creative category, namely in the fluency indicator of 9.54% (uncreative category), the flexibility thinking ability indicator of 18.98% (uncreative category), the originality thinking ability indicator of 57.37% (moderately creative category), the elaboration thinking indicator of 47.17% (moderately creative). In addition, the teacher also stated that the material of rotational dynamics and equilibrium of rigid bodies is material that is difficult for students to accept, especially in the concept of rigid bodies. So that this material becomes one of the challenges for teachers in delivering the material so that students can achieve the predetermined goals. Therefore, teachers need a teaching material that can present material and physics problems that can encourage students to think creatively in an interesting way. For example, by making teaching materials that are integrated with local wisdom around students.

Research on ethnoscience has been done before including (Munandar et al., 2022; Widya et al., 2023) the results showed that many students have a high interest in ethnoscience-based learning activities. Novista et al. (2021) and Rahmayani et al. (2024) the results of the research obtained that 84% of teachers and students strongly agree if a physics module is developed that can improve the quality of student learning by raising the theme of ethnoscience on temperature and heat material (Putri & Puspasari, 2022; Susanti, 2019). The development of local wisdom-based teaching materials that can support students in learning activities with high quality. Almuharomah et al. (2019) and Muliadi et al. (2022) development of local wisdom-based modules by showing the N-Gain value is 0.92 in improving creative thinking.

Method

This development research uses the Rowntree development model. The Rowntree development model consists of three stages: First, the planning stage, consisting of analyzing needs and determining learning objectives; Second, the development stage, which consists of implementing the plan; and Finally the evaluation stage includes implementing the plan and

producing the final form of the product and conducting trials and changes to the product prototype based on previously collected data. In the evaluation stage, researchers used Tessmer's formative evaluation, namely: 1) Self-evaluation; 2) Expert review; 3) One-to-one evaluation; 4) Small group evaluation; and 5) Field test.

The Rowntree method is one of the popular research and development (R&D) methods for producing quality educational products. It was developed by Derek Rowntree in 1977 and has been widely used in various countries, including Indonesia. The Rowntree method has 3 stages in its development process, namely the Planning Stage: At this stage, researchers conduct a needs analysis, formulate objectives, review literature, and prepare a design. Development Stage: At this stage, researchers develop products, conduct expert validation, product trials, and product revisions. Evaluation Stage: At this stage, researchers conduct formative evaluation, summative evaluation, product revision, and report preparation. The following Rowntree development flow chart can be seen in Figure 1.

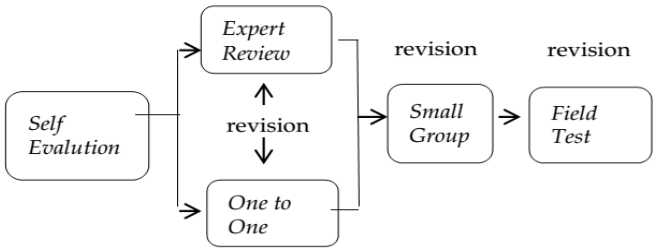

Figure 1. Module development research flow

The research subjects or intended targets in the research are: First, ethnoscience-based Physics Module with local wisdom of Palembang pyramid house to improve creative thinking skills in high school; Second, grade XI students at SMA Negeri 19 Palembang as the subject of a broad trial and as users of the Physics Module at the one-to-one, small group, and field test stages. This research was conducted at SMA Negeri 19 Palembang. The implementation time is from the planning stage which was carried out in July, the development stage was carried out in August-October and the evaluation stage was carried out in November-May 2024.

Data collection techniques are needed to obtain research data and information in accordance with the research objectives. In this researcher, data collection uses the Walkthrough method in the form of questionnaires and tests. Walkthrough is one way to find out an overview of the validity of the product that has been developed. Questionnaires are also often known as questionnaires. The type of questionnaire used in the research is in the form of a Likert scale. The questionnaire was given at the one-to-one and small group stages which aimed to test the practicality of the Module. The test instruments that have been used in this study are in the form of pretest and posttest questions to determine the effectiveness of the Physics Module developed on improving the creative thinking skills of students on the material of rotational dynamics and equilibrium of rigid bodies totaling 10 essay questions. Interviews were conducted with physics teachers in the preliminary study to find out the needs and problems in the learning process.

Data analysis techniques used in this study were descriptive quantitative and qualitative as input to revise the Physics Module produced. The details of the analysis are as follows: 1) Data analysis for validation width. 2) Data analysis for questionnaire sheets (one to one and small group). The instrument used in measuring validity is a validation sheet and a questionnaire sheet in the form of a Likert scale with four categories of answers made in the form of a checklist table. Equation 1 is used to calculate the percentage of expert validation results, one-to-one and small groups (Murdani et al., 2022). 3) Test data analysis is done by summing up the scores obtained from each item that has been done by students. Then the increase in students' creative thinking skills is calculated based on the normalized N-gain score according to Hake (1998) in (Setyoningtyas et al., 2022) by using the equation 2.

$$P = \frac{f}{N} \times 100\% \quad (1)$$

Description:
P = Percentage of practicality
f = Score Acquisition
N = Maximum Score

$$< g >= \frac{posttest - pretest}{skor\ maksimum - pretest} \quad (2)$$

The results of the n-gain calculation were then interpreted using a classification such as Table 1.

Table 1. N-Gain Classification

Average N-gain	Classification
$< g > \geq 0.70$	High
$0.30 \leq < g > < 0.70$	Medium
$< g > < 0.30$	Low

Result and Discussion

The purpose of this research is to develop ethnoscience-based Physics Module products with local wisdom of Palembang pyramid houses to improve students' creative thinking skills in high school. The

development of physics modules on rotational dynamics and equilibrium of rigid bodies to improve creative thinking skills refers to the Rowntree development model which consists of three stages, which include the planning stage, development stage, and evaluation stage. The following are the stages.

Planning Stage Results

The initial stage in this research is planning. From the results of the interview, the physics subject teacher stated that in carrying out learning in the classroom the teacher only used teaching materials in the form of textbooks available at school and there was still no availability of ethnoscience-based Physics modules with local wisdom. The teacher stated that there are still many students who are low in creative thinking skills. Because the learning carried out by the teacher is only limited to lecturing and using teaching materials available from the school, even though there are practice questions in it that have not led students to be able to improve their creative thinking skills. In line with that, Mubarok et al. (2022) stated that in addition to the low grasping power of students, teachers also have difficulty in providing examples and practice questions to students who must adjust to the abilities of students. These problems lead to questions of creative thinking skills. Teachers need a teaching material that can present physics material and questions that can encourage students to think creatively in an interesting way.

Formulation of Learning Objectives

Based on the results of the needs analysis, learning outcomes and learning objectives are obtained as in Table 1 and Table 2 learning outcomes (CP) are learning competencies that must be achieved by students in each phase F. In learning outcomes, Phase F or equivalent to grade 11 SMA is used as in Table 2. The next analysis is in the form of problem formulation from the learning outcomes that have been determined as in Table 3.

Table 2. Phase F Learning Outcomes

Elements	Learning Outcomes
Understanding of Physics	Students are able to apply vector concepts and principles to the kinematics and dynamics of motion, fluids, sound waves and light waves in solving problems

Table 3. Learning Objective Analysis

Learning Outcomes	Learning objectives
Students are able to apply vector concepts and principles to the kinematics and dynamics of motion, fluids, sound waves and light waves in solving problems.	Learners are able to understand the concept of moments of force in everyday life; Learners are able to understand the concept of moment of inertia in everyday life; Students are able to apply the equilibrium of rigid bodies to everyday life; Learners are able to determine the effect on a rigid body in everyday life.

Development Phase Results

In this development stage, there are development steps aimed at designing prototype I, such as topic development, drafting and prototype production.

Evaluation Stage Results

The evaluation stage is the final stage in the development of ethnoscience-based Physics Modules with local wisdom of pyramid houses to improve students' creative thinking skills. This evaluation stage aims to determine the feasibility of the Physics Module when used by teachers and students. The eligibility criteria in this study are the validity level of the Physics Module stated by experts and stated by students for the level of practicality. The self-evaluation stage or initial evaluation is a stage carried out by the researcher himself together with the supervisor to produce prototype I. The prototype I was evaluated by the experts. Prototype I is evaluated by experts called the expert review stage, which has suggestions and comments to be taken into consideration to revise the module.

Table 4. Module Expert Review Results

Aspects	Indicator	Percentage (%)
Content/Material	Suitability of the material to the curriculum	91.66
	The correctness of the substance of the learning material	93.75
	The suitability of the material with the context of ethnoscience and local wisdom	95
	Product suitability with creative thinking skills	100
	Average percentage	95.10%
Appropriateness of presentation and appearance	Accuracy of Presentation	80
	Presentation of Learning	75
	Completeness of Presentation	75
	Module display	75

Aspects	Indicator	Percentage (%)
	Average Percentage	76.25%
	Communicative	100
	Dialogical and interactive	83.33
	Straightforward	87.5
Linguistics	Coherence and coherence of thought	100
	Conformity with Indonesian language rules	87.5
	Appropriateness to learner development	87.5
	Use of terms and symbols	100
	Average Percentage	92.26%
Total Average Percentage		87.87%

The expert review stage consists of content validation, presentation and display feasibility validation and language validation. The experts involved in this stage were two expert lecturers and one Physics teacher. The material expert is an expert in the field of physics material and is one of the lecturers in the Physics Education Master Program at Sriwijaya University. The presentation and display feasibility expert is one of the lecturers in the Physics Education Master Program at Sriwijaya University. Then the linguist is one of the teachers of SMA Negeri 19 Palembang. Each aspect was tested for feasibility and received suggestions from the validators. The results of the expert review can be seen in Table 4.

Based on Table 4, the average results of the analysis of the Physics Module in the material/ content aspect with an average percentage of 95.10% with a very valid category, then in the linguistic aspect with an average percentage of 92.26% with a very valid category and validation of the feasibility of presentation and appearance of 76.25% with a valid category.

One-to-one Evaluation Results

Prototype I at the expert review stage has been declared valid. Then prototype I will be tested at the One-to-one Evaluation stage involving three students of class XI SMA Negeri 19 Palembang. At this stage, students were given a prototype I ethnoscience-based Physics module with local wisdom of pyramid houses. Each learner was invited to read and study the material of rotational dynamics and equilibrium of rigid bodies while still getting directions and instructions from the researcher. Furthermore, students are invited to fill out a questionnaire sheet containing their responses to the prototype I that has been used. The results of the assessment of the students' responses can be seen in Table 5.

Table 5. Recapitulation of One-to-One Evaluation Results

Aspects	Respondents			Average
	1	2	3	
Ease of use	100	100	95	98.33
Attractiveness of the dish	90	95	95	93.33
Benefits	95	87.5	100	94.166
Average				95.27% (Very Practical)

Based on Table 5, the results of the *one-to-one questionnaire* sheet show that the average percentage of the questionnaire responses of students to prototype I is 95.27% with a very practical category. Furthermore, prototype II will be tested at the *small group evaluation* stage.

Small Group Evaluation Results

Prototype II after being declared valid and practical at the previous stage then continued the small group evaluation stage. This stage is almost the same as the one-to-one evaluation, the difference is that the researcher tested the prototype II of the ethnoscience-based Physics module with the local wisdom of the pyramid house to 8 students of class XI SMAN 19 Palembang. Researchers invited students to read, analyze, and discuss the contents of prototype II. The results of the learner response questionnaire assessment are listed in Table 6.

Table 6. Recapitulation of the Results of the Small Group Stage Learner Questionnaire

Learner Name	Percentage (%)
R	96.25
RS	95
AIW	93
AA	92.5
NDP	98.33
KRP	93
B	96.25
MF	98.33
Average	95.33
Category	Very Practical

Based on the recapitulation of the assessment of the small group evaluation stage in Table 6, it shows that

prototype II, namely the ethnoscience-based Physics module with the wisdom of the Palembang pyramid house to improve students' creative thinking skills, is in the very practical category with an average value of 95.33%. In addition to providing an assessment in the form of numbers, students also provide comments and suggestions.

The results of students' responses to the questionnaire at the small group stage. Based on these results, it shows that the ethnoscience-based Physics module with local wisdom of Palembang pyramid houses to improve creative thinking skills is very practical and becomes a reference source for students. After the product is declared valid and practical, it will be continued at the field test stage to see whether the product developed can improve the creative thinking skills of students or not.

Field Test Results

At the Field Test stage, it was conducted in one sample class XI.4 at SMA Negeri 19 Palembang with a total of 39 students with various characteristics. To see the improvement that occurs when students use the physics module, questions will be given in the form of Pretest and Post-test questions consisting of 10 questions tailored to the indicators of creative thinking. The following N-gain analysis results per-indicator of creative thinking skills can be seen in Figure 2.

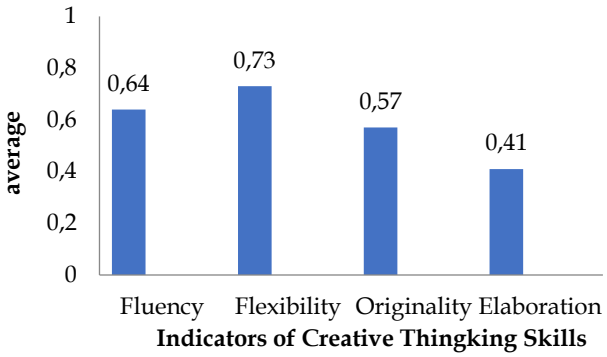

Figure 2. N-gain results per-indicator of creative thinking skills

Based on the results of the figure above, creative thinking skills have four indicators as a reference. Based on the results of the study, it shows that creative thinking skills on fluency indicators (Fluency) are 0.64; flexible thinking indicators (Flexibility) are 0.73; Originality thinking indicators (Originality) are 0.57 and detailed thinking indicators (Elaboration) are 0.41.

This research was conducted to produce an ethnoscience-based physics module with the local wisdom of Palembang pyramid houses that is feasible to use and practical and effective in improving the creative thinking skills of high school students. This research uses the Rowntree development model, which consists of 3 stages, namely the planning stage, the development stage and the evaluation stage. At the planning stage, the results state that it is necessary to provide ethnoscience-based physics modules with local wisdom to improve students' creative thinking skills and facilitate students in learning physics. By developing a physics module based on local wisdom, it can optimize the character of students and can help make science learning more diverse by optimizing wisdom (Hidayanto et al., 2016; Muliadi et al., 2022). These results are in line with research reported by Damayanti et al. (2017), Kinasih et al. (2018), and Lestari et al. (2021), that the use of ethnoscience-based physics modules with local wisdom can improve creative thinking skills.

At the development stage where this stage produces prototype I physics module in accordance with previous planning. The follow-up of this stage is the evaluation stage, namely conducting expert review, one-to-one evaluation and small group evaluation of the prototype I ethnoscience-based physics module with the local wisdom of Palembang pyramid houses to improve students' creative thinking skills, which aims to produce products that are valid based on experts and practical based on users (students). Prototype I developed has been declared valid by experts with an average percentage of 87.87% and practical with an average of 95.27% and 95.33% based on the one to one and small group stages. Some previous studies that also produced similar products, resulted in physics modules integrated with local wisdom of the South Hulu River developed in the category of feasible and practical for use in the learning process (Wati et al., 2017). The ethnoscience-based module on global warming material developed is feasible and practical in training junior high school students' science literacy skills (Lubis et al., 2021).

The physics module that has been declared valid and practical to use prototype III, then conducted an effectiveness test as the final stage of development. The results of the analysis showed that the ethnoscience-based physics module with the local wisdom of Palembang pyramid houses was declared effective for improving the creative thinking skills of high school students in the medium category. The overall N-gain average for improving students' creative thinking skills was 0.62. This research is in line with research conducted by Astuti et al. (2022) that the physics module based on local wisdom on the material of rotational dynamics and equilibrium of firm objects can improve creative thinking skills with the average n-gain result of 0.62.

The N-gain of each aspect of students' creative thinking skills shows results that vary from moderate to high categories. The fluency aspect has effectiveness

with an n-gain score of 0.64 (medium category). There are factors that affect the fluency of students' creative thinking, namely the material or material studied using the physics module based on local wisdom. This is in line with Fadilla et al. (2021) the existence of a link between the material and local wisdom packaged in the module is an effort that can affect the fluency of thinking of students in absorbing physics material easily, as well as being able to motivate students between the knowledge they have and the application of everyday life.

The flexibility aspect showed the highest increase of 0.73. This increase is the highest increase compared to other aspects. There are factors that influence the flexibility of thinking, namely the presence of problem exercises that support creative thinking. This is in line with Haspen et al. (2021) that the exercises and questions provided in the module contain ethnoscience and questions that can increase students' creativity flexibly.

The originality aspect has effectiveness with an n-gain score of 0.57 (medium category). Research Fitriani (2017) revealed that learning by using physics modules can facilitate students to solve problems after reading and understanding independently.

In the aspect of detailed thinking (elaboration) is the lowest aspect compared to other aspects, namely n-gain of 0.41, but this score is included in the moderate category. Learners are able to solve problems with detailed steps. Wahyudi et al. (2019) stated that teachers must be able to create a learning environment that provides opportunities for students to explore knowledge and elaboration so that students become independent by using physics modules.

Conclusion

Based on the results of the discussion, the following conclusions were obtained: The Ethnoscience-Based Physics Module with Local Wisdom of Palembang Limas Houses to Improve Creative Thinking Skills of students in high school has been tested for validity. the average validation on the content aspect is 92.26% (valid), on the feasibility aspect of presentation and appearance is 76.25% (valid) and for the language aspect is 95.10% (very valid); Ethnoscience-Based Physics Module with Local Wisdom of Palembang Limas Houses to Improve Creative Thinking Skills in High School developed has been tested for practicality. This is shown from the results of the one-to-one evaluation stage by obtaining an average percentage value of 95.27% with a very practical category; and the small-group evaluation stage of 95.33% with a very practical category. And learning using the Ethnoscience-Based Physics Module with Local Wisdom of Palembang Limas House has effectiveness for research subjects by improving students' creative thinking skills with an N-Gain of 0.62.

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Author Contributions

Methodology, C. H. S. A.; validation, P. M. Z. and T. R.; formal analysis, R. A. E.; investigation, M. N. S., and C. H. S. A.; resources, P. M. Z. and T. R.; data curation, R. A. E.: writing—original draft preparation, M. N. S and C. H. S. A.; writing—review and editing, P. M. Z.: visualization, and T. R.and R. A. E. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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